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B. T. GALLOWAY, Chief of Bureau.

FORAGE-CROP EXPERIMENTS AT THE SAN ANTONIO FIELD STATION.

BY

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B. P. I.—796.

FORAGE-CROP EXPERIMENTS AT THE SAN ANTONIO FIELD STATION.

INTRODUCTION.[1]

The country about San Antonio, Tex., was an open prairie not many years ago and was covered by a luxuriant growth of native grasses which furnished excellent pasturage. The prairie fires which periodically swept the country kept down the growth of trees and shrubs.[2] As the country became more thickly settled the ranges were overstocked, the native grasses were kept closely cropped, and the mesquite (*Prosopis juliflora*), the native cactus (*Opuntia* sp.), and other shrubby plants covered the ground. At present the forage furnished by the native vegetation, except the cactus, plays a decidedly insignificant part in the agriculture of the region.

Aside from some irrigation farming along the San Antonio River, the early agriculture consisted of stock raising. Crop production on a commercial scale is of comparatively recent date. As the stock ranches have been divided into smaller farms the stockmen have given place to cotton growers and truck farmers, until only a few large stock ranches are left in the vicinity of San Antonio. Some dairy farming has been undertaken, but the demand for dairy products resulting from the rapidly increasing population has increased faster than the supply, until the point has been reached where dairying would be one of the most profitable industries of the region if the necessary forage could be produced at a moderate cost. The breaking up of the large stock ranches into cotton, truck, and dairy farms has increased the need of forage production until it is now an acute problem, for the success of dairying largely depends on the cheapness with which forage can be grown or purchased.

The rainfall in the section is so unevenly distributed that native grasses can not be relied upon to furnish pasture or hay; consequently the supply of forage must depend upon the production of cultivated crops. The increasing demand for roughage has brought the price of forage crops to the point where their production for sale is nearly, if not quite, as profitable as cotton growing. While it is to be expected that cotton will continue to be the most important crop for the dry-land farmer, yet certain forage crops might well be grown on nearly every farm, either for sale or as the basis for live-stock production.

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[1] The information contained in this circular is based on cooperative experiments conducted by the Offices of Forage-Crop Investigations and Western Agricultural Extension of the Bureau of Plant Industry since 1907. The work during the first two years was carried on by Mr. F. B. Headley and since then by Mr. S. H. Hastings.

[2] For a discussion of this subject, see Cook, O. F., "Change of Vegetation on the South Texas Prairies," Circular 14, Bureau of Plant Industry, U. S. Dept. of Agriculture. 1908.

It should be understood, however, that while under present conditions the production of forage may be more profitable than cotton growing, yet if the area devoted to forage crops were greatly increased prices would be depressed unless live-stock production or dairying were also developed. Increasing local production of such a staple as cotton, on the other hand, would have little or no appreciable effect on its market value.

The experiments with forage crops herein reported were conducted on the San Antonio Experiment Farm during the years 1907 to 1912, inclusive. The objects in view were (1) to test forage crops not generally known and select from these the ones best suited to the region and (2) to test the best methods of planting and tillage.

The United States Department of Agriculture has introduced from foreign countries during recent years numerous new or little-known varieties of forage crops, many of which were deemed worthy of trial in this region. These have been on trial in comparison with local varieties. Some very promising new crops have been found, and experiments with methods of planting and tillage have shown that there are better ways of growing forage crops than those now generally followed by the farmers of the region.

CROP SEASONS.

In the San Antonio region the crop seasons are much less definite than in most of the semiarid regions of the United States, because of the mildness of the winter. By proper selection, forage crops may be grown throughout the year, and green forage may be had at any time except during a protracted drought. Oats, rye, and Canada field peas are winter crops and may be planted at any time from October to the latter part of February, with the expectation of securing a crop. The summer crops, such as sorghum, millet, and cowpeas, may be planted from the first of March to the first of August, although very late planting is not recommended. Corn is ordinarily planted soon after February 20.

An examination of the records of the United States Weather Bureau at San Antonio for a period of 20 years shows that the last killing frost of the spring occurs about February 24, but in 1900 it was as late as April 12, and in several years it has occurred in the second or third week of March. The first autumn frost may be expected about November 26, though it often occurs as early as November 12 to 14. A minimum temperature of 4° F. was recorded in the winter of 1899, though the temperature does not usually fall below 18° F.

The weather records show that the region is one of short, mild winters, with a long growing season, characterized, fortunately, by a very early spring. During seasons of unusually heavy rainfall or with irrigation it is possible to grow two different forage crops on the same land in a single season. Where crops are grown without irrigation the important point is to have the land in condition for planting as soon as possible after the previous crop is removed, so that when favorable rains come the next crop may be seeded promptly and the moisture thus utilized before it is lost by evaporation.

RAINFALL.

The mean annual rainfall of the section for the past 20 years has been about 25 inches. Much of this rain, especially during the summer months, comes in torrential storms and falls on soils that are easily compacted, so that the proportion of run-off is large. There are also many light showers, of one-half inch or less, that do not moisten the soil deeply enough to benefit the growing crops, particularly during the summer months. The potential evaporation, as measured by the loss from a free water surface, is very high. It has been shown by Briggs and Belz in their studies of dry farming in relation to rainfall and evaporation in the Great Plains area[1] that the rainfall at San Antonio corresponds approximately to a 20-inch rainfall in Minnesota or South Dakota, the average annual rainfall at San Antonio being approximately 24½ inches. These figures are based on the differences in evaporation in the two localities. The annual evaporation at San Antonio averaged 69.2 inches during the four years 1908–1911.

The following table shows the rainfall records by months for each year since 1907 and the average monthly rainfall for the past 20 years. It will be observed that while the average monthly rainfall is fairly uniform, the actual rainfall for each month is extremely variable and, furthermore, that there are no regular wet and dry seasons.

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[1] Briggs, Lyman J., and Belz, J. O. Dry Farming in Relation to Rainfall and Evaporation. Bulletin 188, Bureau of Plant Industry, U. S. Dept. of Agriculture. 1910.

Table I.—*Monthly rainfall at the San Antonio Experiment Farm for the years 1907–1912, inclusive, together with the averages of the years 1891–1911.*

Month.	Monthly average rainfall, 1891-1911.[1]	Rainfall by months.					
		1907	1908	1909	1910	1911	1912
	Inches.	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*
January	1.35	0.56	0.47	0.00	1.75	0.16	0.31
February	1.47	1.72	2.61	.41	.68	1.73	6.21
March	1.41	1.70	1.27	1.12	.21	3.34	2.30
April	2.84	4.50	2.39	.85	4.40	[2] 3.41	2.00
May	3.01	2.81	5.44	1.72	1.77	1.41	1.64
June	2.19	.31	.88	.72	2.24	.08	3.42
July	2.32	2.65	1.37	2.86	1.12	1.14	.08
August	2.18	.39	3.79	1.75	.45	2.16	....
September	2.43	.64	2.59	.29	.60	1.24	....
October	1.89	2.98	1.62	1.20	3.76	3.09	....
November	1.79	6.78	2.87	.27	1.30	2.13	....
December	1.59	.64	1.50	1.95	1.74	1.53	....
Total	24.47	25.68	26.80	13.14	20.02	21.42	....
Monthly mean	2.04	2.14	2.23	1.09	1.67	1.64	....

[1] Average for the years 1891–1911 from records of the United States Weather Bureau. Rainfall from 1907 to 1912 from records at the San Antonio Experiment Farm.

[2] Record for April, 1911, from the United States Weather Bureau service at San Antonio.

The rainfall for the years 1909 to 1911 was considerably below normal, while that of 1909 was the lowest thus far recorded. Consequently the crop yields reported in these experiments were rather lower than may be expected under normal conditions. The year 1908, as indicated by the crop yields, was perhaps more favorable than normal, although the total rainfall for the year does not indicate it. The heavy rains in November of the preceding year were apparently stored in the soil and used during the season of 1908.

FACTORS INFLUENCING CROP YIELDS.

The yields of forage crops reported in the following pages are extremely variable and often are not significant. They are published as a matter of record, but the interpretation of the experiments should be based on the printed conclusions and recommendations rather than on the figures alone. It is not always clear which way the crop or the treatment of the land the previous season affected the subsequent crop yields. Usually, fallowing land for several months results in larger yields of the following crop, but this is not always the case. The kind of crop grown the previous year also affects the yields obtained. For instance, the small grains, such as wheat or oats, are harvested in May or early in June, corn in July, while cotton and sorghum occupy the land until late in October and use any available soil moisture until harvested. A crop planted the following March or April on land that had been devoted to cotton or sorghum is ordinarily at a disadvantage when compared with a crop on land that had been in oats or corn the previous year.

It has seemed advisable to publish the crop yields even at the risk of some misinterpretation, but in each case it is urged that for purposes of practical application the notes and comments concerning each crop or experiment be given the greater emphasis and that any broad generalizations from the figures in the tables be avoided.

THE SOIL ON WHICH THE EXPERIMENTS WERE CONDUCTED.

The San Antonio Experiment Farm is located in the southern extension of what is called the ''Black Prairie region,'' known geologically as the Upper Cretaceous formation, and is representative of a large portion of central Texas extending from the Oklahoma line to the Rio Grande. The surface soil, which is a black, clayey loam, is capable of absorbing a high percentage of moisture, but tends to puddle and bake. It is very sticky when moist, and all tillage operations are difficult because the plows and cultivators do not scour. The subsoil is of about the same mechanical composition as the surface soil, but it often contains more lime, which occurs as gravelly concretions. The subsoil is also much lighter colored, probably due in part to the lack of organic matter as well as to the larger proportion of lime. When supplied with plenty of water, the soil is usually very productive and has proved well adapted to growing many of the ordinary forage crops.

CROPS ORDINARILY GROWN FOR FORAGE.

The crops that are generally grown in the San Antonio region for forage are sorghum, oats, Johnson grass, millet, cowpeas, and corn, while alfalfa is grown to a limited extent where irrigation water is available. Of the crops mentioned, sorghum, oats, and Johnson grass are the most common, and they rank in the order named in popularity and value. The native wild grasses are used only for pasture. Most farmers grow only sorghum for forage, and consequently it has been deemed advisable to test other forage crops with a view to suggesting some practical diversification as a basis for systematic crop rotation. The native cactus, or Opuntia, is being used as a forage crop and has proved to be a valuable addition to the list, especially during unfavorable seasons.[1]

SORGHUM.

Experiments designed to determine the most prolific varieties, the best methods of planting, the proper rate of seeding, and the best date of planting sorghum have been carried on at the San Antonio Experiment Farm during the past five years.

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[1] For information concerning this crop, consult the following bulletins:

Griffiths, David. The Prickly Pear as a Farm Crop. Bulletin 124, Bureau of Plant Industry, U. S. Dept. of Agriculture. 1908.

——— The "Spineless" Prickly Pears. Bulletin 140, Bureau of Plant Industry, U. S. Dept. of Agriculture. 1909.

——— The Thornless Prickly Pears. Farmers' Bulletin 483, U. S. Dept. of Agriculture. 1912.

Sorghum may be planted any time from March 1 to August 1 with the expectation of securing a crop, although as a rule the earlier the planting the larger the yield. When planted early in March, from two to four cuttings can be obtained from the earlier maturing varieties, such as Red Amber, while from the later maturing varieties, such as Sumac, two or three cuttings can be obtained under favorable conditions.

The varietal tests in 1908 indicated that Sumac and Red Amber were the best varieties for this region; hence, all later tests were carried on with these two varieties only. Table II gives the results of a test of varieties in 1908, which was an unusually favorable year. It has been observed that an unfavorable season often magnifies the differences in favor of the better varieties

TABLE II.—*Yield of sorghum varieties grown in one-tenth acre plats at the San Antonio Experiment Farm in 1908.*

S. P. I. No.	Variety.	Date planted.	Number of cuttings.	Yield per acre.
				Tons.
17554	Sumac	Mar. 30	2	12.29
17548	Red Amber	...do....	3	10.17
17556	Orange	Mar. 18	2	7.12
17539	Planter's Friend	...do....	2	6.00
20799	Minnesota Amber	...do....	3	5.38
17569	Kafir	...do....	2	4.83
18684	Dwarf milo	...do....	2	4.38

The sorghum was planted in rows 4 feet apart and the plats were one-tenth of an acre in size. As will be seen from Table II, the Sumac is the heaviest yielder of the varieties tested, but the hay is somewhat coarser than that from the other varieties. On the whole, the Sumac is deservedly the most popular variety grown. (Pl. I, fig. 1.)

In 1910 a comparative test of the Red Amber and Sumac sorghums was carried out under irrigation. Table III gives the results of this test.

TABLE III.—*Comparative test of the Red Amber and Sumac sorghums grown under irrigation at the San Antonio experiment farm in 1910. Triplicate plantings.*

Red Amber sorghum.		Sumac sorghum.	
Number of cuttings.	Yield per acre.	Number of cuttings.	Yield per acre.
	Tons.		*Tons.*
3	14.41	2	14.75
3	12.45	2	14.00
3	11.62	2	12.60
Average.	12.83	....	13.78

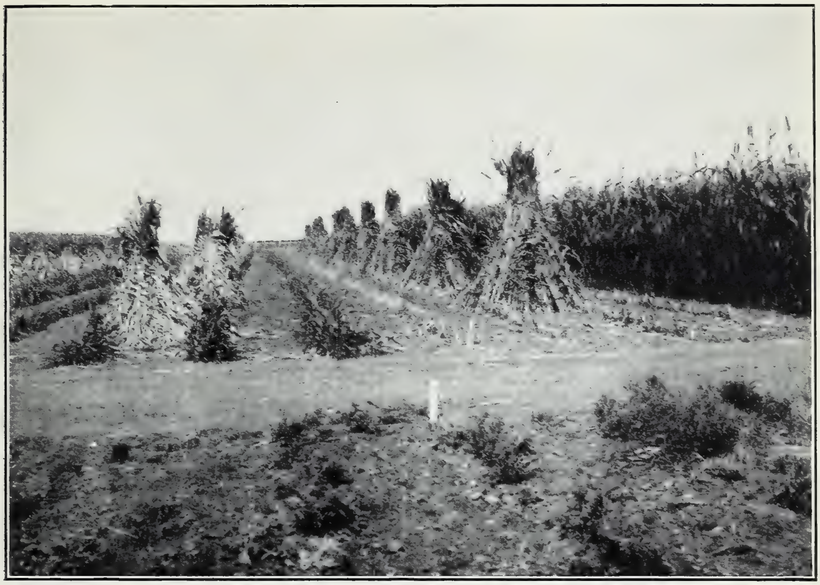

FIG. 1.—SORGHUM IN SHOCK, SHOWING THE METHOD OF HARVESTING WHEN A HEAVY CROP IS GROWN. AS MUCH AS 13 TONS PER ACRE OF THE SUMAC VARIETY HAS BEEN GROWN WITHOUT IRRIGATION.

(Photographed June 8, 1908.)

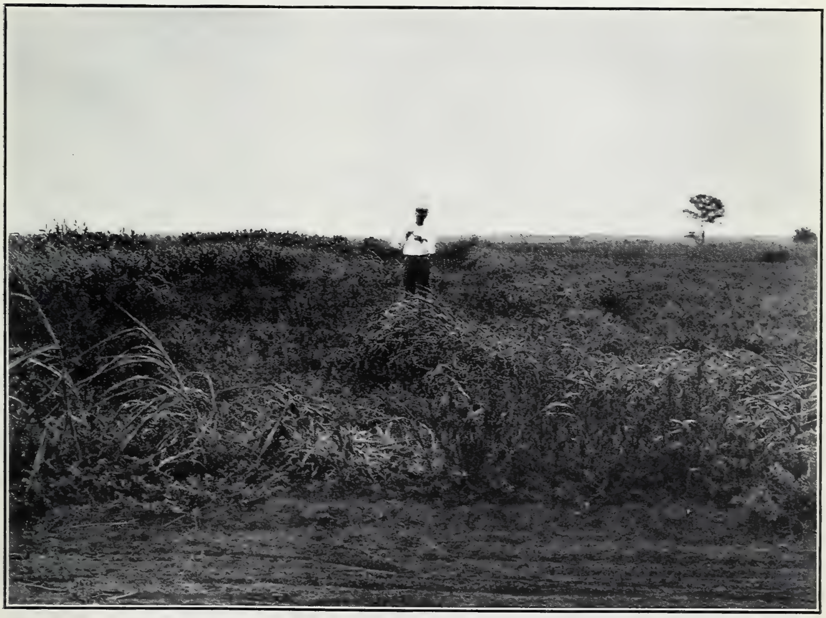

FIG. 2.—BROADCASTED SORGHUM ON FIELD B5-6. THERE WAS PRACTICALLY NO HAY YIELD FROM THIS PLAT.

(Photographed July 27, 1910.)

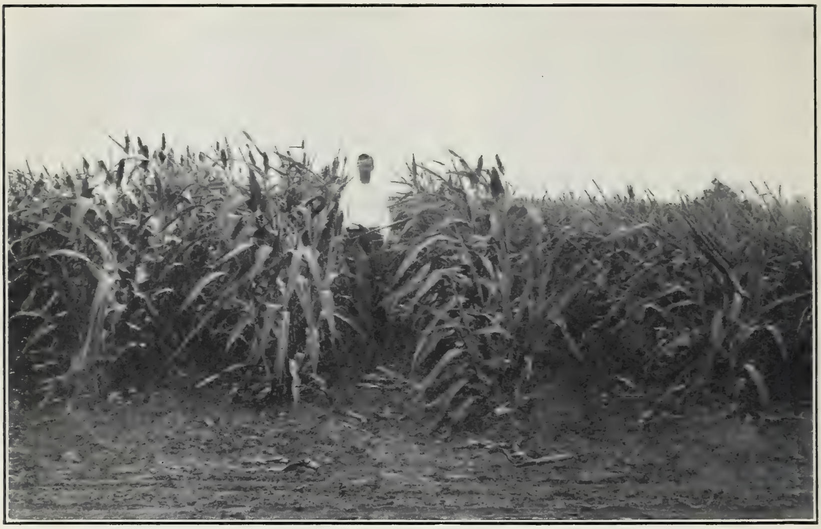

FIG. 1.—DRILLED SORGHUM ON FIELD B5-14. THE HAY YIELD FROM THIS PLAT WAS 3.76 TONS PER ACRE.

(Photographed July 27, 1910.)

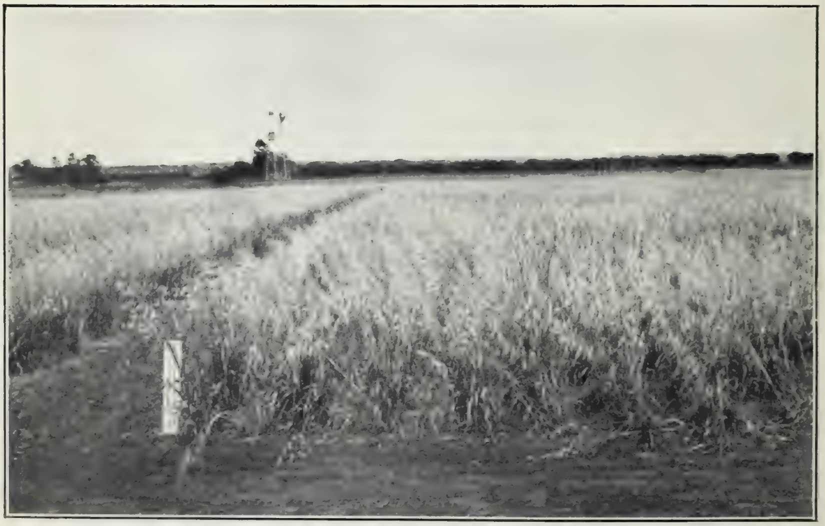

FIG. 2.—A PLAT OF THE APPLER RUSTPROOF OATS. PROBABLY THE BEST VARIETY FOR THE SAN ANTONIO SECTION.

(Photographed May 17, 1910.)

It will be observed that the average yield from the three plats of the Sumac variety was nearly a ton larger than from the three plats of the Red Amber. Another point in favor of the Sumac variety is that there were only two cuttings of the Sumac, while there were three of the Red Amber, and it costs more to harvest three crops than two.

METHODS OF PLANTING.

Two methods of planting are practiced by farmers, namely, planting in rows far enough apart so that cultivation is possible, and planting closer, either in drills or by broadcasting. Practically no sorghum is grown under irrigation in cultivated rows, but in recent years an increasingly large area is being planted on dry land in cultivated rows. When sorghum is planted in rows and cultivated, the crop may have to be harvested with a grain harvester or by hand if there is a heavy growth, but if the rows are not more than 2 feet apart or the growth is not too heavy it may be cut with a mowing machine and handled in the ordinary manner. Even with the rows 4 feet apart the sorghum at the field station the past four years has been harvested in the same way as broadcasted sorghums.

Drilled compared with cultivated rows.—The yields from sorghum grown without irrigation have been larger when planted in cultivated rows than when the crop was sown broadcast or in 8-inch drills. Unfortunately, this comparison was not made in 1908, which was a very favorable season. Table IV gives the yields in this experiment for the years 1907 to 1911.

TABLE IV.—*Yields per acre of Sumac sorghum planted in cultivated rows 4 feet apart and in 8-inch drills.*

Method.	1907		1908		1909		1910		1911		Average for four years.
	Number of plats.	Average yield.	Number of plats.	Average yield.	Number of plats.	Average yield.	Number of plats.	Average yield.	Number of plats.	Average yield.	
		Tons.		*Tons.*		*Tons.*		*Tons.*		*Tons.*	*Tons.*
Rows 4 feet apart	5	3.20	4	13.02	4	1.68	4	3.06	4	3.44	2.84
8-inch drills	2	1.68	......	([1])	3	1.07	3	.74	3	4.36	1.96

[1] There were no plats of Sumac sorghum close-planted in 1908.

The great difference in yield between the cultivated plats and those in 8-inch drills in 1910, the comparatively slight difference in 1909, and the difference in favor of the 8-inch drills in 1911 are due to the seasonal rainfall. As will be noticed by reference to the rainfall table (Table I), the year 1908 was a very favorable one and much moisture that collected in the soil was carried over to 1909, while 1909 was exceedingly dry, and 1910 was more favorable during the early part of the season. The cultivation of the sorghum in 4-foot rows conserved a large part of the rainfall for the use of the crop, while the plats in 8-inch drills were dependent entirely upon the season's rain, as there was very little moisture carried over from 1909 and the rain that did fall was lost very quickly by evaporation. Up to about May 1 the spring of 1911 was unusually favorable, the rains coming so frequently that considerable periods passed when it was impossible to cultivate. Thus, before May 1 cultivation did not affect the yields as much as it would otherwise have done and the shortage of rain in June prevented a second cutting, enabling the drilled plat to outyield the cultivated plat. When a series of years is considered, it is safe to conclude that for unirrigated land planting in rows, so that cultivation is possible, will increase the yields enough to justify this method of planting. (Pl. I, fig. 2, and Pl. II, fig. 1.)

The effect of the two systems of cultivation on the succeeding crops is also important. In the rotation experiments in 1911 there was a slight difference in the yield of corn and a very noticeable difference in the cotton yield in favor of the land on which sorghum had been grown in cultivated rows the previous year. Under irrigation the advantage was still with the cultivated rows. In rows 3 feet apart the yield was 14.41 tons per acre, while in 8-inch drills the yield was 12.6 tons. The difference in yield is, however, comparatively slight; and when one considers the expense of cultivating the rows, the quality of the forage, and the greater ease of handling the broadcasted sorghum it is doubtful whether it is profitable under irrigation to plant in rows and cultivate.

Width of rows.—A test was made in one-tenth-acre plats of sorghum planted in rows, 2, 3, and 4 feet apart. Table V shows the yields from these plats.

TABLE V.—*Yields of Sumac sorghum planted in rows 2, 3, and 4 feet apart.*

Distance between rows.	Yield per acre.		
	1910	1911	Average.
	Tons.	*Tons.*	*Tons.*
2 feet	5.07	3.30	4.19
3 feet	5.90	2.82	4.36
4 feet	5.00	3.30	4.15

The plats of 1910 were planted in a field summer-fallowed in 1909, and consequently the yields are not comparable with those given in Table IV. The land on which the experiment was conducted in 1911 was cropped the previous year. In both years the quality of the forage was best on the plat with the rows 2 feet apart, with the forage from the rows 3 feet feet apart second in quality. While the differences are not great, yet the quality of the forage was so much better from the closer plantings and cultivation with the ordinary farm machinery so much easier that undoubtedly a closer planting than 4 feet is advisable.

Rate of seeding in rows.—In 1910 a test of Sumac sorghum in rows 4 feet apart, with the plants 1, 2, 4, and 6 inches apart in the row, was attempted. Owing to poor germination there was not much difference in the resulting stands of the different plats, so that the results were of no comparative value. Table VI shows the yields of this experiment as carried out in 1911, the rows being 4 feet apart as before. The figures are based on averages of actual counts of plants at the end of the growing season.

TABLE VI.—*Yields of Sumac sorghum with the plants different distances apart in the row.*

Distance between plants.	Yield per acre.	Distance between plants.	Yield per acre.
	Tons.		*Tons.*
2 inches	3.30	7 inches	2.05
4 inches	2.76	8 inches	1.97

These results are definite and conclusive, as they show very clearly the effect of reducing the thickness of the stand. There has been some discussion relative to the effect of thick seeding on the yields in cultivated rows, and the foregoing results bear directly on this question. Aside from the increased yields, the quality of the forage is so much better in the thicker seedings that if the yield were somewhat less where thicker seeding is resorted to this method would still be advisable.

Rate of seeding test in 8-inch drills.—There appears to be a wide difference of opinion in this locality regarding the proper rate to seed sorghum broadcasted or in close-drilled rows. To throw some light on the subject, the following test was made.

On April 29, 1912, seven plats of one-tenth acre each were seeded to Sumac sorghum in 8-inch drills, the rate of seeding varying from 25 pounds to 174 pounds per acre. Table VII presents the results of the experiment.

TABLE VII.—*Rate-of-seeding test of Sumac sorghum in 8-inch drills.*

No. of plat.	Seed per acre.	Yield per acre.
	Pounds.	*Tons.*
1	26	4.54
2	37	4.97
3	52	5.12
4	88	5.27
5	121	5.01
6	153	4.55
7	174	4.90

This season the best results were obtained from sowing 88 pounds to the acre, with 52 pounds and 121 pounds second and third, respectively. With these results as a basis, to seed a much greater or less amount does not appear to be advisable.

The quality of the hay on plat 4 was fully as good as on the plats with a thicker seeding, and was naturally much better than on plats 1 and 2.

SORGHUM-LEGUME MIXTURES.

In 1908 a series of experiments was begun to test the growing of legumes intermixed with sorghums for forage. Considering the extent to which sorghum is grown and the way it reduces the productivity of the land on which it is grown continuously, there seems to be need of some practical way to lessen the injury to the soil, as well as to produce a better balanced ration. This work has a direct bearing on the production of a better quality, as well as on the maintenance of the quantity of forage produced.

METHODS OF PLANTING.

Different varieties of cowpeas and other legumes and several different methods of planting were tested in 1909 on a small scale, to determine as far as possible from one year's work the best varieties to grow and the best methods for growing them. The sorghum varieties were the Sumac and the Red Amber and the legume varieties the Iron, Whippoorwill, and Unknown cowpeas and a variety of kulthi (*Dolichos biflorus*). Two methods of planting were adopted in 1909, the row method and the band method. The band method consisted of planting two rows of sorghum 2 feet apart, with one row of the legume between, the bands being planted 3 feet apart and the intervening space kept cultivated. In the row method the sorghum and legume seeds were planted in the same row, the rows being 4.1 feet apart and the ground kept cultivated between the rows. The band method was not as successful as the row method, apparently because the legumes did not receive the benefit of cultivation. Of the legumes used in the mixtures, the cowpeas did the best, the Unknown cowpeas being on the whole slightly better than any of the other varieties. Table VIII gives the yields of the mixtures. There was one-thirtieth of an acre in the plats planted by the band method and one-fortieth of an acre in those planted by the row method. The land was summer-fallowed the preceding year and was a Johnson-grass meadow previously.

TABLE VIII.—*Comparison of the row and band methods in 1909, on land summer-fallowed the preceding year.*

Mixture.	Yield per acre.	
	Row method.	Band method.
	Tons.	*Tons.*
Sumac sorghum	3.00	3.27
Iron cowpeas		
Sumac sorghum	3.20	3.63
Unknown cowpeas		
Sumac sorghum	2.20	3.75
Whippoorwill cowpeas		
Sumac sorghum	4.32	4.44
Kulthi (*Dolichos biflorus*)		
Average	3.18	3.77

TABLE IX.—*Comparison of the row and band methods in 1910 on land cropped to sorghum the preceding year.*

Mixture.	Yield per acre.	
	Row method.	Band method.
	Tons.	*Tons.*
Sumac sorghum	1.45	1.76
Unknown cowpeas		
Sumac sorghum	1.33	1.18
Brabham cowpeas		
Sumac sorghum	1.11	.70
Kulthi (*Dolichos biflorus*)		
Pearl millet	.93	1.17
Kulthi (*Dolichos biflorus*)		
Average	1.21	1.21

Of the cowpeas planted by the band method fully 50 per cent died before reaching maturity, while the legumes planted by the row method made a good growth, although the sorghum was too thick, not allowing the legumes to develop as well as they probably would have done had the sorghum plants been farther apart. The band method, it will be noted, outyielded the row method in 1909, but this was due to the predominance of the sorghum and is no indication of the comparative success of the two methods, as the forage from the row method contained a much greater percentage of cowpeas. The total yield from the two methods of planting was the same in 1910, but the value of the forage from the row method was much higher, owing probably to the fact that the cowpeas had a better chance to develop than when the band method was used.

A test of mixtures seeded in 8-inch drills was made under irrigation but was entirely too thick, so that the legumes were crowded out. The yields were about the same as would have been expected had the sorghums been planted alone. It is very doubtful whether it is advisable to plant the sorghum-legume mixtures under irrigation in this manner, and it is certainly not advisable to do so without irrigation. Even with a thin rate of seeding the sorghum plants stool profusely and have a tendency to crowd out the shorter leguminous plants. So far, none of the tests with this method of planting have been satisfactory.

On a field which was fallow in 1909 and planted in Johnson grass previously, a rate-of-seeding test for sorghum-legume mixtures was made in 1910, to determine as far as possible in one year's test the best proportion of each seed for the mixture. The row method of planting was adopted and the rows were 3½ feet apart, the plats being one-tenth of an acre in size. Sumac sorghum and Unknown cowpeas were the varieties used in this test. Table X shows the results of this test.

TABLE X.—*Yields of rate-of-seeding test of sorghum-cowpea mixtures, planted by the row method in 1910.*

Mixture.	Stand, plants in 50 feet.	Number of cuttings.	Yield per acre.
			Tons.
Sorghum	95	2	4.77
Cowpea	90		
Sorghum	74	2	5.15
Cowpea	100		
Sorghum	70	2	4.02
Cowpea	105		
Sorghum	30	2	2.35
Cowpea	100		

With all points considered, the second plat showed the best rate of seeding, although a test of one year is not conclusive. (Fig. 1.)

In the first plat the sorghum appeared to be a little too thick and crowded the cowpeas, reducing the quantity of forage from them. In the case of the last two plats the sorghum was entirely too thin, making it rather coarse, but the cowpeas made an excellent growth.

While the combination of sorghum and cowpeas is recommended, especially for the irrigation farmer, yet it should be borne in mind that extreme care must be exercised to secure the proper mixture. If the sorghum is too thick, the cowpeas will not properly develop and the forage will be little better than if the sorghum were planted alone. On the other hand, if there is too great a proportion of cowpeas the yield will be materially reduced and will prove a disappointment to the grower.

Sumac sorghum is undoubtedly the best variety to use when these mixtures are planted, owing to its leafy character and slow growth at the beginning of the growing season. Early-maturing sorts like the Red Amber crowd out the cowpeas.

The yields from the plats of sorghum indicate that fully as much fodder can be obtained in the mixture as by seeding alone; therefore, the advantage derived from the admixture of the cowpea hay, if not obtained at too great an expense in seeding and cultivation, is well worth while.

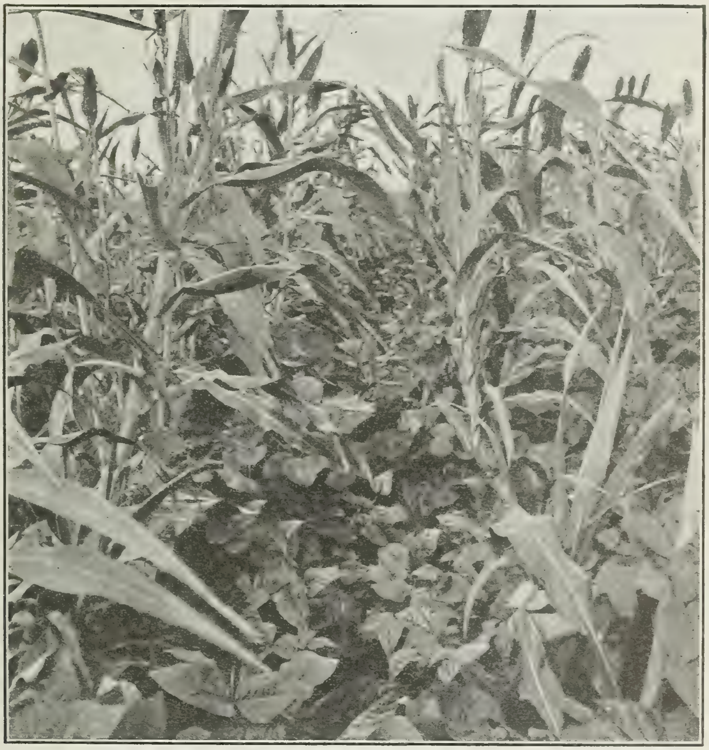

FIG. 1.—Sumac sorghum and Unknown cowpeas planted in the same row, showing the excellent growth made by both the cowpeas and the sorghum. There are about three plants of the sorghum to four of the cowpeas. (Photographed July 27, 1910.)

SMALL GRAINS AS FORAGE CROPS.[1]

While in the immediate vicinity of San Antonio the grain yields from such cereals as oats, barley, wheat, and rye are low, yet oats, and rye to a lesser extent, are quite extensively grown for forage. Oats are also very useful for winter pasturage, and are generally a profitable crop. The oats are ordinarily seeded in October or November and are not pastured until the plants are well established, which is some time in December, depending on the weather conditions. If a hay crop is to be secured, the stock is taken off as soon as the spring growth starts. Little is known as to the extent of the damage done to the crop by grazing, but farmers believe that the winter pasturage alone in a year of normal rainfall is worth all it costs.

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[1] The growing of cereals for grain production only at low altitudes in the vicinity of San Antonio is not a profitable venture. The principal cause of low yields is the susceptibility of grains to rust. In higher altitudes cereals are grown to a considerable extent. In the high land near Kerrville, and even no farther distant than the town of Boerne (30 miles), satisfactory yields have been realized from wheat and oats.

Table XI shows the yields of oats grown during the years 1908 to 1911. In 1910 three local varieties were obtained to compare with four varieties introduced by the United States Department of Agriculture. These varieties were the Texas Red Rustproof, Hastings' Hundred Bushel, and the Winter Turf. The plats were one-fifth of an acre in size, and the land had been summer-fallowed the preceding year in each case.

TABLE XI.—*Yields of oats hay at the San Antonio Experiment Farm, in 1908–1911, inclusive.*

Variety.	Yield of hay (for single plats, except as indicated).				
	1908	1909	1910	1911	Average.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Appler Rustproof	4,720	2.399	[2] 1,474	1,855	2,624
Culberson Winter	4,170	[1] 1,990	[2] 1,146	Failed.	1,826
Texas Red Rustproof			1,260	2,120	1,690
Hastings' Hundred Bushel			800	2,130	1,465
Winter Turf			[3] 2,000	1,730	1,865
Virginia Gray			[3] 1,780		1,780
Snoma			[3] 940		940

[1] Averages of four plats.
[2] Averages of five plats.
[3] The actual weight on these plats was less than the figures indicate, as the hay was not thoroughly dry when weighed.

From the tests made thus far the variety of oats known as the Appler Rustproof has proved to be the best for this locality, although the 1911 test apparently does not indicate this superiority. The low yield of the Appler Rustproof oats in 1911 was probably due to the following causes: The four plats, which were planted with different rates of seeding, were located north of four plats of Culberson winter oats, which were so severely affected with rust that they were not worth cutting. As the prevailing winds are from the southeast, the rust spores were undoubtedly carried from the Culberson Winter oats to the Appler Rustproof oats, causing a much more severe infestation than would otherwise have been the case. A plat of Appler Rustproof oats on the south side gave a hay yield of 2,260 pounds, and the average yield of this variety in the rotation plats was 2.437 pounds per acre. (Pl. II, fig. 2.)

Since the Appler Rustproof oats proved to be the best, in the fall of 1909, 39 half-bushel lots of these oats were sent to different farmers in the San Antonio region. Later a circular letter was sent out, requesting a report on the results obtained with the variety, and its value as compared with the variety ordinarily grown. Twenty-six replies were received, of which 11 were favorable, 3 unfavorable, and the remaining 12 equally divided—6 did not think the test was satisfactory, and 6 found little difference between this variety and that commonly grown.

In 1909 a rate-of-seeding test was made to determine the rate that would give the highest yield. The varieties of oats planted were Appler Rustproof and Culberson Winter. Table XII presents the results of the test.

TABLE XII.—*Yields of Appler Rustproof and Culberson Winter oats in a rate-of-seeding test, 1909.*

Variety.	Rate of seeding.	Approximate number of seeds per acre.	Yield per acre.	
			Straw.	Grain.
	Pounds.		*Pounds.*	*Bushels.*
Culberson Winter	59	2,124,000	1,750	6.87
Do	43	1,550,000	1,835	7.85
Do	28	1,008,000	2,065	11.76
Do	23	828,000	2,310	13.05
Appler Rustproof	59	950,000	2,600	19.06
Do	43	700,000	2,500	18.00
Do	30	480,000	2,225	16.13
Do	24	384,000	2,200	13.44

Apparently conflicting results were obtained in this test. With the Culberson Winter oats the lightest seeding nearly doubled the grain yield and gave an increased yield of 560 pounds of hay. With the Appler Rustproof oats, however, the heaviest seeding yielded 5.62 bushels of grain and 400 pounds of hay more than the lightest. By taking a count of the oats it was found that there were about two and one-half times as many seeds of the Culberson Winter oats as there were of the Appler Rustproof oats in a single pound, so that in the heaviest seeding of the latter the number of seeds per acre was only slightly greater than the lightest seeding of the former. Although it is to be expected that the seasonal variations will change the results somewhat, yet the results from the season of 1909 indicate that 2 bushels of seed per acre is about the right quantity to sow. This test shows conclusively that the same rates of seeding of two varieties are not necessarily comparable and that the size and weight of the seed are important factors to be considered.

For further information as to the best rate of seeding this experiment was repeated in 1910. Table XIII shows the yields for the year.

TABLE XIII.—*Yields in a rate-of-seeding test of Appler Rustproof and Culberson Winter oats, in 1910.*

Variety.	Rate of seeding.	Yield per acre.	
		Straw.	Grain.
	Pounds.	*Pounds.*	*Bushels.*
Appler Rustproof	71	1,890	21.5
Do	59	1,225	14.0
Do	45	1,609	16.4
Do	30	1,320	15.2
Culberson Winter	37	1,000	8.6
Do	28	1,200	7.2
Do	23	1,280	9.1
Do	14	1,050	6.6

With Appler Rustproof oats the heaviest seeding gave the highest yield, but with Culberson Winter oats there was so little difference that the deviation could be attributed to variation in the soil.

OTHER SMALL GRAINS THAT MAY BE USED AS FORAGE CROPS.

Other small grains which have been tested for use as forage crops are wheat, barley, emmer, and rye. Table XIV shows the yields from these cereals. These plats were one-tenth of an acre in size and the land was summer-fallowed the previous season.

TABLE XIV.—*Hay yields from various cereals tested for forage.*

Cereal.	Hay yield.	
	1910	1911
	Pounds.	*Pounds.*
Abruzzes rye	2,480	3,380
Rieti wheat	1,100	....
Black winter emmer	1,740	....
Barley	[1] 800	[2] 1,951

[1] Average yield from six varieties.

[2] Average yield from eight varieties.

With the exception of rye, none of the cereals mentioned in Table XIV gives indications of being of any great value for this section, from a forage standpoint. With the exception of rye, all those listed are very susceptible to rust. While the variety of rye grown appears to be somewhat better than oats from the standpoint of yield, yet the value of oat hay is somewhat higher. Rye comes second on the list of cereals for hay and is recommended next to oats.

OTHER FORAGE CROPS.

JAPANESE SUGAR CANE.

A one-tenth-acre plat of Japanese sugar cane was planted at the field station on March 22, 1910. This is a forage crop of value in Florida

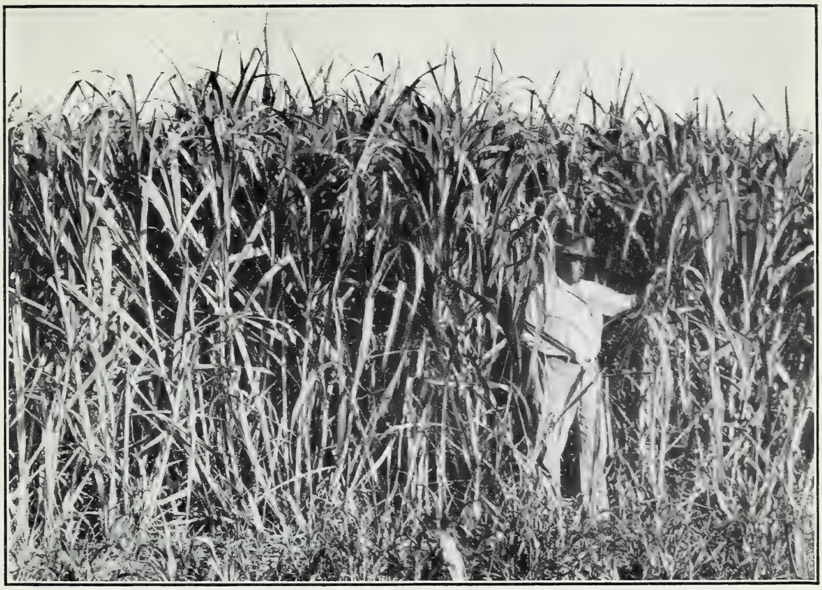

FIG. 1.—JAPANESE SUGAR CANE GROWN UNDER IRRIGATION. A PROMISING CROP FOR THE IRRIGATIONIST.

(Photographed November 1, 1910.)

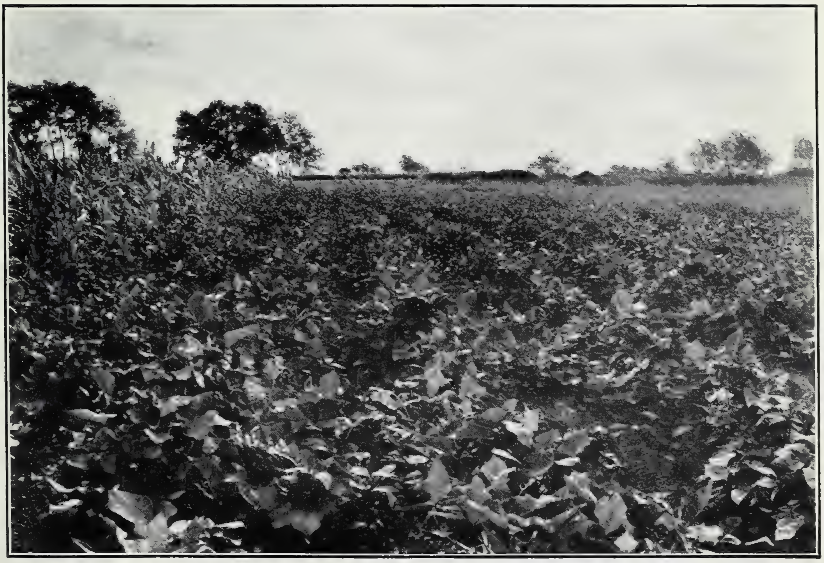

FIG. 2.—UNKNOWN COWPEAS PLANTED IN ROWS 3 FEET APART. COWPEAS ARE A CROP THAT SHOULD BE MORE WIDELY GROWN IN THE SAN ANTONIO SECTION.

(Photographed July 27, 1910.)

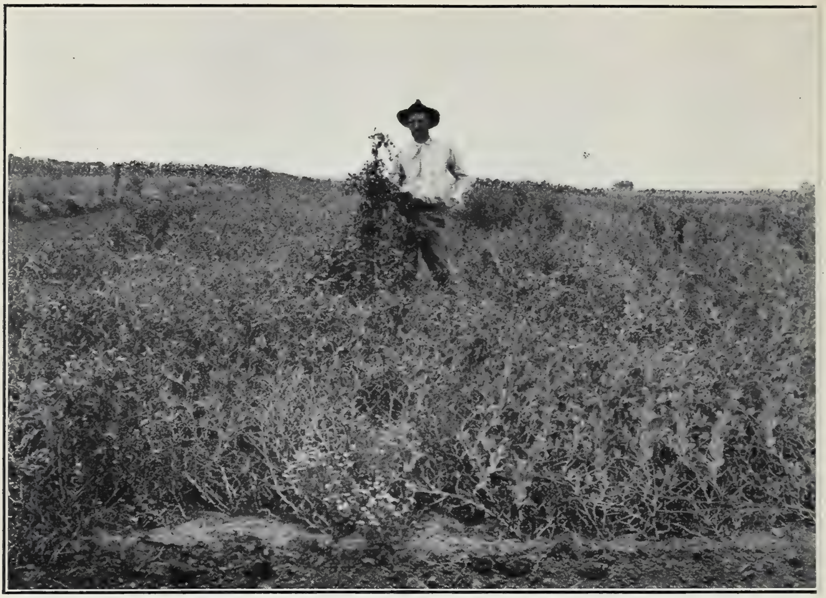

FIG. 1.—CANADA FIELD PEAS GROWN WITHOUT IRRIGATION. THESE PEAS GAVE A YIELD OF 1.9 TONS PER ACRE.

(Photographed May 19, 1911.)

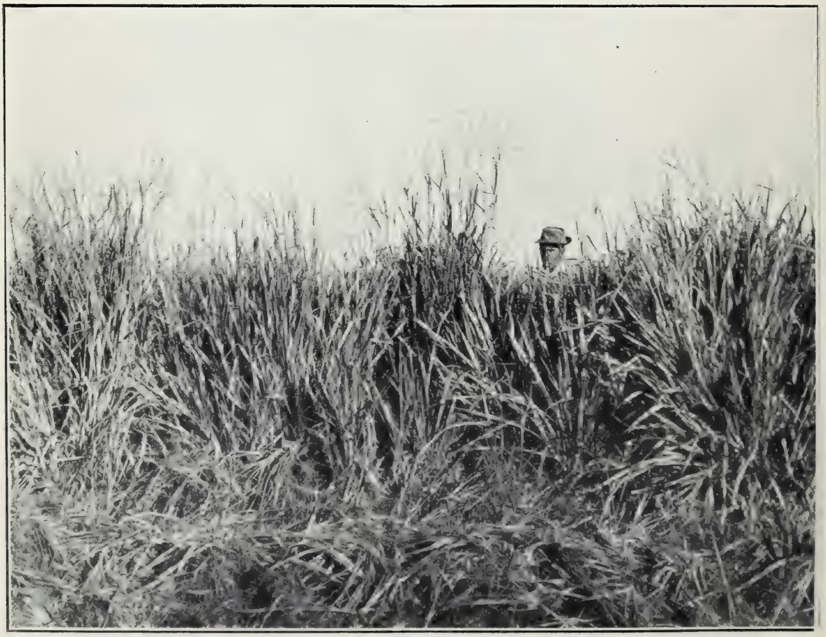

FIG. 2.—GUINEA GRASS GROWN UNDER IRRIGATION. THIS GRASS HAS POSSIBILITIES AS A FORAGE CROP WHEN IRRIGATED.

(Photographed November 1, 1910.)

and the Gulf coast region. The yield from the plat, planted under irrigation, was 13.5 tons per acre in 1910, and 11.95 tons per acre in 1911. (Pl. III, fig. 1.) To obtain the best results late fall planting is recommended. This cane promises to be a valuable addition to the list of forage crops that can be grown under irrigation in this section, as it makes a large yield of very palatable fodder.

In the plats tested the canes were planted in furrows about 6 inches deep and 6 feet apart. Ordinary cultivation was given the crop. Mr. John M. Scott, in a recent bulletin,[1] says that the number of whole canes required to plant an acre is about 3,000. He suggests that the rows be made about 8 feet apart and that the canes be cut in pieces having three or four eyes to each piece and dropped in a double line. There is some reason for believing that a closer planting than 8 feet may be advisable in Texas as the canes would then be less coarse.

ALFALFA.

A number of tests have been made with different varieties of alfalfa and with different methods of seeding this crop. None of the results so far obtained have been sufficiently satisfactory to warrant alfalfa being grown on a commercial scale without irrigation. The principal reason for this difficulty seems to be that in the immediate locality of San Antonio it is not possible to store enough moisture in the soil to carry the plants over the periods of drought that occur in the summer. If there were no loss by surface run-off and evaporation, both of which are important factors in the section mentioned, the crop could probably be grown at a profit without irrigation. Alfalfa is being grown successfully in some localities in this region under irrigation, but apparently is not adapted to this section unless it can be irrigated occasionally.

In 1907 a series of plantings of a number of varieties of alfalfa were made in 6-inch drills, in single rows 2 feet apart and in double rows about 8 inches apart, with a cultivated space of 24 inches between. These plats were not irrigated. Of the three methods of planting, the double-row method, with the intervening space kept cultivated, proved to be the best, although the yields from the plats planted in this manner were so low that they were not profitable, even during the favorable season of 1908. Six strains were also seeded in broadcast plats in December, 1906. Two of the plats died out almost entirely, the stand in many of them being reduced to 5 or 10 per cent. Several plats seeded September 25, 1906, gave much better results, the stand in October of the following year being about 90 per cent. Thorough inoculation of the soil seemed to be decidedly beneficial, the plat inoculated with soil giving much the best growth. The cuttings continued so light, however, that there was not sufficient return for the expense of culture.

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[1] Scott, John M. Japanese Sugar Cane for Forage. Bulletin 105, Florida Agricultural Experiment Station.

TABLE XV.—*Comparative yields of varieties of alfalfa.*

S. P. I. No.	Source of variety.	Yield per acre.
		Pounds.
12549	Argentina	400
12846	Tripoli	320
14786	Turkestan	480
18627	Arabia (irrigated seed)	120
18628	Arabia (nonirrigated seed)	400
18664	Provence, France	80

The best yield made by alfalfa in rod-square plats was 880 pounds an acre at one cutting. The other cuttings were only clippings made for the purpose of protecting the alfalfa from the drought as much as possible.

Four varieties of alfalfa were seeded under irrigation in one-tenth of an acre plats in September, 1909. Two of these plats were almost completely ruined, and the other two badly injured by root-rot before July, 18, 1910. The root-rot proved, perhaps, more destructive than usual in these plats.

POSSIBILITIES OF ALFALFA.

Where alfalfa is grown in the vicinity of San Antonio under irrigation it is generally necessary to replant the fields or portions of them every fall. Where this is done the reported yields indicate that alfalfa is a fairly satisfactory forage crop. On the Sewer farm, south of San Antonio, five to eight cuttings are ordinarily obtained, although the last cuttings are light and mixed with native grass and weeds. Where root-rot has destroyed the plats the vacant areas are taken up by grass and weeds.

It must be admitted that the possibilities of alfalfa in soils infested with root-rot are limited, and the writer has yet to see a cultivated field of any area in the black soil of this section that is not infested with this fungus. That the light, sandy soils south of San Antonio are in some instances less infested, if not entirely free from the fungus, has also been observed, but whether these isolated areas are of sufficient extent to permit the establishment of permanent alfalfa fields is yet to be demonstrated. The best superficial method of determining whether the root-rot fungus is in the soil is to observe the cotton fields. If there are small areas of varying size with dead cotton plants, the farmer will be safe in concluding that the fungus is in his fields.

CLOVER.

So far, only one variety of clover appears to be adapted to this section. This is called shaftal clover (*Trifolium suaveolens*). Only one test was made with this crop, but the plants made an excellent growth, and this clover may have possibilities as a winter forage, although it is rather susceptible to low temperatures when not well established. Five other clovers have been tested, including two varieties of crimson clover (*Trifolium incarnatum*), and one variety of sweet clover (*Melilotus alba*). The best plat of crimson clover, which was planted in November, 1907, gave a yield of 1,240 pounds per acre the following spring. The plat of sweet clover gave a yield of 1,640 pounds per acre. These plats were one-twentieth of an acre in size. Neither of the last two clovers was at all promising.

COWPEAS.

The cowpea is apparently as well adapted to the section of San Antonio as any other leguminous plant that has been on trial. It is of value as a forage crop, but is particularly useful as a green manure, and in a well-planned rotation there is no more valuable plant. One great difficulty with the local soil is its compactness and tendency to run together and bake. Plowing under a crop of cowpeas every three or four years will do much to make the soil more friable, and if the rotation is well planned the yields should eventually be increased.

The best results have been obtained from growing cowpeas in cultivated rows about 3 feet apart. No complete failure of this crop has been recorded in the five years it has been grown, and good yields have been secured under favorable conditions. Ordinarily from 1½ to 2½ tons of hay per acre are obtained, although under favorable conditions the yields may be greater. Several varieties have been grown, but those that have proved best adapted to local conditions are the Whippoorwill and the Unknown. (Pl. III, fig. 2.)

TABLE XVI.—*Yields of cowpeas without irrigation.*

S. P. I. No.	Variety.	Yield per acre.	
		1909	1910
		Tons.	*Tons.*
24919	Red Ripper	0.40	
25078	Groit	.68	
24414	Brabham	.72	1.38
17330	Chinese Whippoorwill	.92	
26849	Unknown		1.93

CANADA FIELD PEAS.

For a winter legume the Canada field pea does fairly well. In the winter of 1908–9, which was extremely unfavorable, a fair crop was produced, and an excellent crop was grown during the winter of 1907–8. This pea does not successfully withstand the hot summer weather, and consequently it can be grown profitably only as a winter crop. The peas should be planted about the first of November or earlier, in order to become well established before a severe freeze occurs. Later planting sometimes proves successful, but it is not generally advisable. It is necessary to plant early enough to have the crop mature before the hot months of the summer. In this respect Canada field peas are much like oats.

A somewhat larger test was made during the winter of 1910–11, when three varieties were grown. Owing to the severe freeze of January all of the varieties were killed nearly to the ground and some of them were killed outright. S. P. I. No. 22042 (McKay) proved to be the hardiest of those grown. Three plats one-tenth of an acre in size were devoted to as many different methods of planting.

TABLE XVII.—*Yields in 1911 of Canada field peas planted alone and with oats in 1910.*

Method of planting.	Rate of seeding.	Yield of hay per acre.
	Pounds.	*Tons.*
Peas and oats mixed, proportion 1 to 5, 12-inch drills	112	1.23
Peas alone, 12-inch drills	120	1.94
Peas and oats mixed, proportion 1 to 5, 24-inch drills	56	1.16

It is doubtful whether any combination with oats will give as high a yield as when the peas are grown alone, as will be seen from the yields shown in the table. It will be observed by consulting Table XI that the peas gave a much larger yield than did any of the varieties of oats (Pl. IV, fig. 1), and being a leguminous crop they also improved the soil on which they were grown. The hay is extremely palatable, and being rich in protein it is of value to mix with oat or sorghum hay. As a winter green-manure crop it is of particular value.

A rather more extensive test of this crop was made in the winter of 1911–12. About 50 varieties bearing S. P. I. numbers were planted in 1-rod rows, but owing to the ravages of birds it was necessary to replant, making the resulting crop so late that the test was of little practical value.

Plantings in the orchards on the farm resulted more satisfactorily. S. P. I. Nos. 18806 (Erfurt), 30307 (Canadian Beauty), and 30134

(Golden Vine) were seeded with a grain drill. Nos. 18806 and 30307 were completely destroyed by the unusually severe winter, but No. 30134 came through with practically a perfect stand. The hay yield from this planting was at the rate of 2,783 pounds per acre and the grain yield 14 bushels. The hay yield in this instance does not represent what it would have been had the vines not been allowed to mature. The vines were so ripe when cut that the greater part of the leaves dropped off.

OTHER LEGUMES.

Table XVIII gives the yields of a number of leguminous crops tested in 1909.

TABLE XVIII.—*Yields of legumes in 1909.*

S. P. I. No.	Variety.	Yield per acre.
		Pounds.
21286	Kulthi (*Dolichos biflorus*)	320
22025	Bonavist beans (*Dolichos lablab*)	460
17534	.....do	520
21600	Moth beans (*Phaseolus aconitifolius*)	900

Four species of Stizolobium bearing S. P. I. numbers were tested in 2-rod rows in 1910 and gave promise of being desirable legumes for this section. No. 24870 (the Bengal bean, *Stizolobium aterrimum*) and No. 25715 (the Florida velvet bean, *S. deeringianum*) were the most promising. The only objection to this legume which has been suggested is its slow growth. From the time of planting to the flowering of *S. deeringianum* 164 days intervened. The quantity of forage was much greater than that produced by any other legume that has been on trial.

MILLET.

As was noted in a previous publication,[1] millet may be used to advantage as a catch crop when an early crop of hay is desired or when the seasonal rains are very late. A crop may be matured in 40 to 60 days, and a yield as high as 1 to 1½ tons of hay per acre has been obtained from the better varieties of early-maturing millet. The slower growing varieties give, as a whole, a somewhat larger yield per acre under favorable moisture conditions, but they are not so sure of maturing as the early ones. On the whole, millet is not as desirable as many other forage plants, because of its lack of drought resistance. Table XIX shows the yields of the varieties tested in 1908.

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[1] S. H. Hastings. The Work of the San Antonio Experiment Farm in 1908. Circular 34, Bureau of Plant Industry, U. S. Dept. of Agriculture. 1909.

TABLE XIX.—*Number of days necessary to mature several varieties of millets grown in 1908, with yield of hay.*

S. P. I. No.	Variety.	Time to mature.	Yield per acre.
		Days.	*Tons.*
21533	Kutki (*Panicum psilopodium*)	108	2.50
21287	Shama (*Panicum colonum*)	76	1.93
22340	German (*Chaetochloa italica*)	52	1.70
22425	.....do	52	1.65
21601	Sanwa (*Panicum frumentaceum*)	122	1.60
22423	Common (*Chaetochloa italica*)	48	1.57
22420	Kursk (*Chaetochloa italica*)	40	1.56
22426	Hungarian (*Chaetochloa italica*)	43	1.50
22427	Japanese (*Panicum frumentaceum*)	45	1.34
22424	Siberian (*Chaetochloa italica*)	43	1.25
21074	Broom-corn millet (*Panicum miliaceum*)	45	.25
22422	.....do	40	.25

Pearl millet (*Pennisetum americanum*) was grown in 1910 under irrigation. It gave two cuttings, totaling 10.3 tons per acre, but the hay was of poor quality and the yield less than that of Sumac sorghum under like conditions.

In 1909 and 1910 tests were made, but the season was very unfavorable and practically no hay yields were obtained.

On the whole, millets are not to be recommended for use in the cropping system in the locality of San Antonio, since they are not dependable as a crop without irrigation, and under irrigation certain grasses are much more productive.

GRASSES.

Up to the present time no perennial grass except Johnson grass has survived for any great length of time and given a satisfactory yield in the locality of San Antonio. There is need of a good grass, especially by the irrigation farmer, owing to the fact that alfalfa, clovers, etc., are attacked by root-rot and that none of the grass family are subject to this disease. Johnson grass is grown commercially in a few cases, but on the whole it is rightfully considered more of a pest than a profitable crop. Owing to the nature of its rooting system it is capable of withstanding long periods of drought without dying out, but its culture should be discouraged, as there are much more profitable grasses without the objectionable features of Johnson grass which can be grown in its place.

Para grass (*Panicum barbinode*) has been tried, and although it made a luxuriant growth under irrigation at the field station, when it was tried without irrigation it made practically no growth and completely died out during the season of 1909. The plat that was irrigated proved somewhat difficult to handle on account of the thick mass of roots which had formed during the two years the grass was being tested. The ground on which it was grown was very difficult to plow, requiring four heavy mules hitched to a sulky plow to break the land in the spring. This may be an objection to its being grown on a large area, unless the roots are allowed to decay before plowing. In the coast country it is being grown quite extensively and the reports show it to be a valuable pasture and hay grass. If the field is not irrigated for a season it is said that there is no difficulty in plowing the land.

The plat of Para grass just mentioned was transplanted in field D3 in February, 1909, but was not irrigated that year. In 1910 this plat received eight irrigations and a hay yield of 4.65 tons was obtained.

Guinea grass (*Panicum maximum*) has also been tried and appears to be somewhat more promising than Para grass. The plat was treated the same way as the plat of Para grass and in 1910 gave a yield of 5.29 tons per acre in two cuttings. This grass sets seed freely, while Para grass has not been known to seed in this country. On the plat of guinea grass the stand was very thin in 1909, but in 1910 there was an excellent stand brought about by the grass reseeding itself. (Pl. IV, fig. 2.)

In July, 1910, a one-eleventh-acre plat was planted to Rhodes-grass (*Chloris gayana*), which made a very satisfactory growth. From two cuttings 4.5 tons per acre of very excellent hay was obtained.

Owing to the somewhat severe winter of 1910–11 the spring stand of grass from all these plats was very poor, as they had been badly winterkilled. As this has not happened before, there is no reason for making an adverse report on any of the varieties until more extensive trials have been made.

MINOR FORAGE CROPS.

LENTIL.

Six varieties of lentil (*Ervum lens*) were planted in February, 1908. None of the varieties tested gave promise of sufficient value to warrant extensive experimentation.

MUNG BEANS.

In the spring of 1908 two varieties of urd (*Phaseolus max*), S. P. I. Nos. 16129 and 17309, and one variety of mung bean (*Phaseolus radiatus*), S. P. I. No. 16793, were tested. While these beans proved somewhat more promising than some other leguminous plants tested, they did not show indications of equaling either cowpeas or stizolobiums, and so were discarded.

CHICK-PEAS.

In March, 1908, seven varieties of chick-peas (*Cicer arietinum*) were tested. These varieties seem not to be adapted to this district.

GUAR.

In 1906 and 1907 a plant introduced from India called guar (*Cyamopsis tetragonoloba*) was tested. While this made an excellent growth and proved to be a most drought-resistant plant, the only live stock that would eat it were sheep and goats. The stalk is rather inclined to be woody, the foliage scant, and the seeds small, although it is very prolific. The fact that stock did not eat the guar may have been due in part to the age which the plants were allowed to reach before being harvested.

In India the pods are said to be used as a vegetable, while in other cases it is used as a stock food or as a green-manure crop. According to Sir George Watt,[1] when the plant is cultivated as a vegetable it is grown on highly manured land and apparently is well supplied with moisture, as it is generally planted in May and irrigated until it rains. The unsatisfactory showing made by the plant here may have been caused partly by a lack of appreciation of the requirements of the plants in order to secure the best results, as the tests were made without irrigation and during comparatively dry years. It is probable that the greatest value of guar for this section will be as a green-manure crop.

VETCHES.

About 30 different lots of vetches were tested on irrigated land during the winters of 1906–7 and 1907–8, but none of them showed indications of being a reliable winter crop. Under the most favorable conditions the better varieties made a fair growth, but when the conditions were at all adverse, especially as to moisture supply, the growth was very unsatisfactory. Of the varieties tested, hairy vetch (*Vicia villosa*) and scarlet vetch (*V. fulgens*) made the best showing. Further trials of the vetches under irrigation are needed.

SOY BEANS.

In 1907 and again in 1910 several varieties of soy beans were planted and were entirely destroyed by rabbits, as the areas planted were small. Undoubtedly either large areas will have to be grown or the farm inclosed in a rabbit-proof fence if this crop is to be grown successfully.

RAPE.

A plat of Dwarf Essex rape was grown during the winter of 1906–7. While the plants made a strong early growth, they were later badly affected by the drought, and in February were attacked by the harlequin cabbage bug, which entirely destroyed the crop.

PEANUTS.

A plat of Spanish peanuts was grown in 1908. While the plants made a fair growth, yet their behavior in this heavy black soil and the unevenness of the distribution of rainfall make the growing of the crop in this section inadvisable.

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[1] Watt, George. The Commercial Products of India, pp. 449–450.

SUMMARY.

Though cotton has heretofore been the principal crop of the San Antonio region, the increasing demand for roughage has made forage crops as profitable as cotton.

Crop seasons are such that green forage may be available during the entire year under favorable conditions.

In the selection of crops drought resistance is of primary importance; the consideration of earliness is probably second in importance.

Sorghum is the most widely planted forage crop of the section, and the Sumac variety has given the highest yields.

Sorghum planted in rows so that cultivation is possible has given better yields on nonirrigated land than that sown in 8-inch drills. Rows 3 or 3½ feet apart are preferable to those of either a greater or less distance, yield and quality considered.

Oats and rye are valuable as winter forage. The Appler Rustproof oats have given the highest yields of seven varieties grown.

Japanese sugar cane is a new forage crop well adapted to this section.

Alfalfa can not be successfully produced without irrigation. On irrigated land frequent reseeding is necessary to maintain the stand on account of root-rot.

Cowpeas are the best summer leguminous crop for this section. The Whippoorwill and the Unknown have proved to be the best varieties of those tested.

Canada field peas have proved particularly well adapted to the local conditions in the vicinity of San Antonio as a winter crop.

Millets are not as well adapted to these conditions as many other forage crops because of their lack of drought resistance.

No perennial grasses are grown without irrigation except Johnson grass, and the growth of this is not recommended.

Para grass (*Panicum barbinode*) and guinea grass (*P. maximum*) have given fair yields when grown under irrigation.

Rhodes-grass (*Chloris gayana*) appears to be somewhat more promising than either Para grass or guinea grass.

Approved:
JAMES WILSON,
Secretary of Agriculture.

WASHINGTON, D. C., *November 9, 1912.*

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